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DEVELOPMENT AND OPTIMIZATION OF CURCUMIN UFASOMAL VAGINAL GEL USING DoE APPROACH

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ABSTRACT

The present study aimed to develop and characterize a Curcumin-loaded ufasomal vaginal gel for vaginal cancer therapy to enhance drug permeation and therapeutic efficacy. Curcumin, a BCS Class IV drug with low solubility and permeability, was incorporated into ufasomes using the ethanol injection method. A Central Composite Design (CCD) was employed to optimize formulation variables, including oleic acid, Span 60, and cholesterol concentrations. The optimized formulation was evaluated for entrapment efficiency, particle size, zeta potential, *in vitro* drug release, and vesicle morphology. The optimized ufasomal formulation exhibited an entrapment efficiency of 61.8 ± 0.012%, particle size of 138 nm, zeta potential of 8.5 mV, and drug release of 78.2 ± 0.859% after 8 hours. FTIR and DSC studies confirmed the absence of drug–excipient interactions, while SEM revealed spherical vesicles with smooth morphology. The vaginal gel formulation showed desirable pH, viscosity, spreadability, and drug-content uniformity. These results suggest that the developed Curcumin-loaded ufasomal vaginal gel provides controlled drug release and could serve as a promising vaginal delivery system for improving the therapeutic efficacy of Curcumin in vaginal cancer.

KEYWORDS: Curcumin, Ufasomes, Vaginal Gel, Vaginal Cancer, Central Composite Design.

INTRODUCTION

Vaginal cancer is a rare malignancy accounting for approximately 1–2% of cancers of the female reproductive system. It is diagnosed when the tumour originates in the vagina rather

than spreading from the cervix, vulva, uterus, ovaries, breast, or other nearby organs. Metastatic involvement of the vagina is more common than primary vaginal cancer and is often associated with advanced disease. Abnormal vaginal bleeding, particularly in postmenopausal women, is one of the most common clinical symptoms.[1]

The disease is observed mainly in postmenopausal women; however, cases in younger women have increased because of persistent high-risk human papillomavirus (HPV) infection. Vaginal cancer is classified according to its cell of origin. Squamous cell carcinoma, arising from the epithelial lining of the vagina, is the most common type and accounts for nearly 90% of cases. Adenocarcinoma arises from glandular cells, while clear-cell adenocarcinoma is a rare subtype associated with prenatal exposure to diethylstilbesterol (DES). Vaginal melanoma and sarcoma are other rare forms originating from melanocytes and connective or muscular tissues, respectively.[2]

Treatment depends on the stage, size, and location of the tumour and may include surgery, radiotherapy, chemotherapy, or a combination of these approaches.[3] However, conventional treatment is frequently associated with systemic toxicity, poor selectivity toward tumour cells, damage to healthy tissues, and severe adverse effects that may reduce patient compliance and quality of life. Moreover, many anticancer drugs have poor aqueous solubility, rapid metabolism, low bioavailability, and inadequate drug concentration at the target site, which can limit therapeutic efficacy.

To address these limitations, localized vaginal drug-delivery systems have gained attention as alternatives to conventional systemic therapy. Vaginal delivery can provide direct drug administration to the affected site, reduce first-pass metabolism, improve local drug concentration, and support sustained or controlled drug release. This route may reduce dosing frequency and systemic adverse effects. Nevertheless, achieving adequate drug retention, mucosal permeation, stability, and controlled release within the vaginal environment remains a major formulation challenge.

Natural phytoconstituents have attracted considerable interest in cancer therapy because of their safety and diverse pharmacological effects. Curcumin, a naturally occurring polyphenolic compound isolated from the rhizome of *Curcuma longa*, exhibits antioxidant, anti-inflammatory, antimicrobial, antimutagenic, antiproliferative, and anticancer activities.[4] It can inhibit cancer-cell proliferation, modulate inflammatory pathways, and induce

apoptosis. However, Curcumin has poor aqueous solubility, low permeability, rapid metabolism, and low bioavailability. As a BCS Class IV drug, its therapeutic potential is limited unless an appropriate carrier system is used to improve its solubility, stability, and permeation.

To overcome these drawbacks, ufasomes have emerged as promising vesicular drug-delivery carriers. Ufasomes are stable unilamellar vesicles composed of unsaturated fatty acids and were first described by Deamer and Bangham in 1976.[5] They form in the pH range of approximately 7–9, where ionized and unionized fatty-acid molecules self-assemble into bilayer vesicles. Their amphiphilic structure permits the incorporation of both hydrophilic and lipophilic drugs.[6]

Ufasomes offer advantages such as biocompatibility, biodegradability, improved drug entrapment, enhanced permeability, controlled release, and lower cost compared with liposomes. Their flexible vesicular membrane can enhance drug transport across biological membranes, while the bilayer structure protects the entrapped drug and supports sustained release. Unsaturated fatty acids, particularly oleic acid, can improve membrane fluidity and drug permeation. Cholesterol improves membrane rigidity and stability, reduces drug leakage, and enhances vesicle integrity. Span 60 acts as a non-ionic surfactant that supports vesicle stabilization, dispersibility, particle-size control, and entrapment efficiency.[7,10]

Incorporation of Curcumin-loaded ufasomes into a vaginal gel can improve formulation retention, spreadability, ease of application, and patient acceptability. The gel base can also prolong contact with the vaginal mucosa and support sustained drug release, thereby improving local drug availability while minimizing systemic exposure.[11]

Therefore, the present study was undertaken to develop, optimize, and evaluate a Curcumin-loaded ufasomal vaginal gel for potential vaginal cancer therapy. Curcumin-loaded ufasomes were prepared by the ethanol injection method, and Central Composite Design was applied to evaluate the effects of oleic acid, Span 60, and cholesterol on entrapment efficiency and *in vitro* drug release. The optimized formulation was characterized for vesicle size, zeta potential, morphology, compatibility, and release behaviour, followed by incorporation into a vaginal gel base and evaluation of its pharmaceutical properties.

MATERIALS AND METHODS

Curcumin was procured as a gift sample. Oleic acid was used as the unsaturated fatty-acid component for ufasomes preparation, Span 60 as the non-ionic surfactant, and cholesterol as the membrane-stabilizing agent. Ethanol was used as the organic solvent in the ethanol injection method. Carbopol 934 was used for preparation of the vaginal gel base. Triethanolamine, methanol, potassium dihydrogen phosphate, sodium hydroxide, and other analytical-grade reagents were obtained from established chemical suppliers and used without further purification. Double-distilled water was used throughout the formulation and evaluation studies.

Preparation of Curcumin Loaded Ufasomes by Ethanol injection method

The ufasomes of Curcumin were prepared by the ethanol injection method. Initially, the required amount of Curcumin was accurately weighed and completely dissolved in ethanol, serving as the organic solvent. To this solution, the required quantities of cholesterol, oleic acid, and Span-60 were added, and the mixture was stirred on a magnetic stirrer at an optimum speed until a uniform solution was obtained. Separately, 20 mL of acetate buffer (pH 4.5) was preheated to 60 °C using a water bath. The drug-ethanol mixture was then slowly injected into the preheated buffer under continuous stirring at 250-300 rpm. Upon mixing, ufasomes were formed, which were subsequently examined under a microscope for confirmation of vesicle formation.[12,15]

Experimental Design

Curcumin-loaded ufasomes were optimized by varying the concentrations of oleic acid, span 60, and cholesterol to obtain suitable vesicular characteristics and controlled drug-release performance. Central Composite Design (CCD), a response surface methodology-based statistical optimization tool, was employed to evaluate the effects of selected formulation variables on the critical quality attributes of the ufasomal system. The independent variables selected for optimization were oleic acid concentration (X_1), Span 60 concentration (X_2), and cholesterol concentration (X_3), whereas entrapment efficiency (Y_1) and cumulative *in vitro* drug release (Y_2) were selected as dependent response variables which is shown in Table 1.

The experimental design was generated using Design Expert software (Version 13, Stat-Ease Inc., Minneapolis, MN, USA). A three-factor, two-level Central Composite Design was selected, and the intermediate levels were generated by the software. A total of 13 formulations were prepared according to the software-generated design matrix as shown in

Table 2. The run order was randomized to minimize the influence of time-related variables and to satisfy the statistical requirement of independence of observations.

Table 1: Variables selected for Central Composite Design.

Independent variable	Levels		
	Low	Medium	High
A: Ethanol	6.3	12.6	19
B: Span 60	4	6	8
Dependent Variables			
R1: Entrapment Efficiency			
R2: *In-vitro* Drug Release			

Table 2: Matrix of Central Composite Design of Curcumin Loaded Ufasomes Evaluation of Curcumin Loaded Ufasomes.

STD	RUN	FACTOR 1 Oleic acid (mg)	FACTOR 2 Span 60 (mg)	Cholestrol (mg)	Ethanol
11	1	32.5	100	5	20
3	2	15	150	5	20
9	3	32.5	100	5	20
12	4	32.5	100	5	20
6	5	57.248	100	5	20
8	6	32.5	170.711	5	20
5	7	7.7512	100	5	20
1	8	15	50	5	20
10	9	32.5	100	5	20
2	10	50	50	5	20
13	11	32.5	100	5	20
7	12	32.5	29.2893	5	20
4	13	50	150	5	20

Determination of Entrapment Efficiency

The entrapment efficiency of all Curcumin-loaded ufasomal formulations was determined and formulations showed satisfactory drug entrapment, which may be attributed to the lipophilic nature of Curcumin and the presence of oleic acid and cholesterol in the vesicular bilayer. These components improved vesicle stability and supported drug encapsulation.

$$\%EE = \frac{\text{Amount of entrapped drug}}{Total\ amount\ of\ drug} X\ 100$$

Drug Content Determination

A defined volume of Curcumin Loaded Ufasomes dispersion was transferred to a volumetric flask and diluted using phosphate buffer (pH4.5). After filtration, the solution was analysed spectrophotometrically at 420 nm to determine total drug content.

Scanning Electron Microscopy

The optimized Curcumin-loaded ufasomes were evaluated by Scanning Electron Microscopy to determine their morphology. The SEM micrographs revealed spherical vesicles with smooth surface morphology and uniform distribution. These findings confirmed successful formation of the Curcumin-loaded ufasomal vesicles.

Particle Size and Zeta Potential Analysis

Particle-size analysis of the optimized Curcumin-loaded ufasomal formulation showed a vesicle size of 138 nm. The nanosized vesicles are expected to improve drug permeation and localized delivery of Curcumin through the vaginal mucosa.

The zeta potential of the optimized Curcumin-loaded ufasomal formulation was found to be 8.5 mV. This value indicated satisfactory stability of the vesicular system and uniform dispersion of the ufasomal particles.

***In-vitro* Diffusion Study**

The *in-vitro* drug-release study of Curcumin-loaded ufasomes was performed using a Franz diffusion cell with acetate buffer of pH 4.5 as the receptor medium. Samples were withdrawn at predetermined time intervals and analysed to determine the cumulative percentage drug release. The release profiles of the formulations demonstrated controlled and sustained release behaviour.

Release Kinetics Study

The results of in-vitro release data obtained from diffusion studies were fitted into various kinetic models as follows:

- Zero order kinetics
- First order kinetics
- Higuchi model
- Korsmeyer-Peppas model

FORMULATION AND EVALUATION OF CURCUMIN LOADED UFASOMAL GEL

The optimized Curcumin-loaded Ufasomes were successfully incorporated into a Carbopol 934 gel base to prepare Curcumin Ufasomal vaginal gel. The prepared gel was smooth, homogeneous, and suitable for vaginal application.

1. pH Determination

The pH of each gel batch was recorded using a pre-calibrated digital pH meter with the electrode submerged directly into the gel sample.

2. Viscosity

Rheological characterization of the ufasomal gel was performed using a Brookfield viscometer under defined experimental settings.

3. Spreadability

The spreading behaviour of the gel was assessed by measuring the extent of gel spread between two glass plates under a standard applied load.

4. In-vitro Drug Diffusion Study

Membrane-based drug diffusion from the ufasomal gel was assessed using a Franz diffusion cell assembly with acetate buffer (pH 4.5) as the acceptor medium. Samples collected at scheduled intervals were analyzed by UV spectrophotometry at 420 nm.

RESULTS AND DISCUSSION

Entrapment efficiency was determined across all thirteen formulations (F1–F13). The prepared Curcumin Loaded Ufasomes systems demonstrated encapsulation efficiencies in the range of 76.68±0.22% to 85.59±0.72%, with formulation F3 exhibiting the highest encapsulation value. *In vitro* diffusion profiling revealed distinct differences in drug release behaviour across 13 formulations containing varying ratios of Span 60 and Ethanol. Cumulative drug permeation across formulations F1 to F13 ranged from 61.24±0.79% to 86.48±0.16% over the 8-hour experimental period as shown in Figure 1.

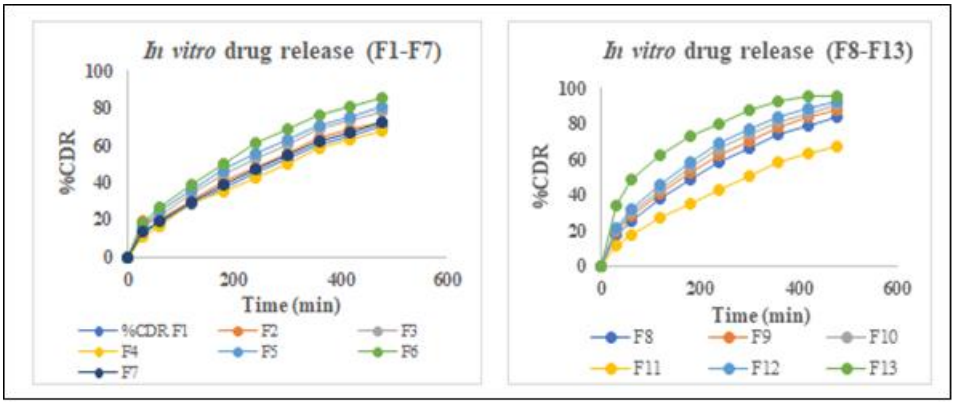


Figure 1: Percentage *In-vitro* drug release of formulation (F1 -F13).

Correlation coefficients (r^2 values) and kinetic parameters derived from fitting the release data of F1–F13 indicated that the Higuchi model best described the drug release profiles, reflecting sustained release behaviour. Application of the Korsmeyer–Peppas model demonstrated non-Fickian (anomalous) transport, as indicated by n values ranging from 0.5670 to 0.6976. These findings collectively suggested that drug release from the ufasomal systems occurred via a combined mechanism encompassing diffusion, matrix swelling, and matrix erosion, confirming the sustained-release nature of these nanocarrier systems.

Response Surface Methodology (RSM) allowed systematic optimization of formulation parameters by establishing quantitative relationships between the independent variables (factors) and the measured responses. CCD via Design-Expert software generated multiple experimental runs based on the defined factor space. Model fitting identified the linear model as most appropriate, and ANOVA confirmed statistical significance of both Span 60 and Ethanol, each yielding p-values below 0.05.

A two-variable CCD response surface framework was applied to study the joint influence of varying concentrations of Span 60 and Ethanol on *In Vitro* diffusion (%) and entrapment efficiency (%) of the ufasomes. This design enabled evaluation of both linear and interactive effects with a manageable number of experimental runs.

The contour diagram for entrapment efficiency exhibited concentric, evenly spaced is response curves, reflecting a smooth and predictable influence of Span 60 and Ethanol concentrations on drug encapsulation. Encapsulation efficiency increased proportionally with rising concentrations of both components. The corresponding 3D response surface displayed a well-defined peak at intermediate factor levels, confirming optimum encapsulation at mid-

range concentrations. At extreme concentration values, efficiency declined slightly, likely due to vesicular structural destabilization or membrane disruption leading to drug leakage.

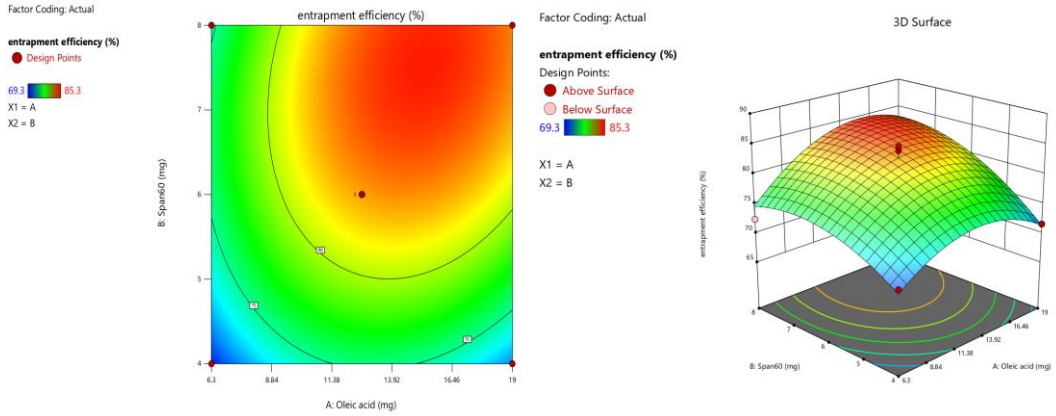


Figure 2: 3D contour diagrams illustrating relationship among the various factors on Entrapment efficiency.

Figure 2 presents the response surface analysis for entrapment efficiency (%) as a function of Oleic acid (X1) and Span 60 (X2), ranging from 69.3% to 85.3%. The contour plot showed smooth, evenly spaced response bands, indicating a gradual, proportional change in entrapment efficiency with variation in the two factors. Efficiency increased progressively with rising Span 60 concentration, reaching a maximum (>81%) at higher Span 60 (6–8 mg) combined with moderate-to-higher Oleic acid (11–14 mg), while the lowest values (~69–73%) occurred at low levels of both factors. The 3D surface plot corroborated this trend, showing a dome-shaped rise toward the high-Span 60 region and a depressed zone at low Oleic acid–low Span 60 combinations, likely due to insufficient surfactant to stabilize the vesicular bilayer. These results confirmed an optimal factor combination higher Span 60 with moderate-to-higher Oleic acid for maximizing entrapment efficiency.

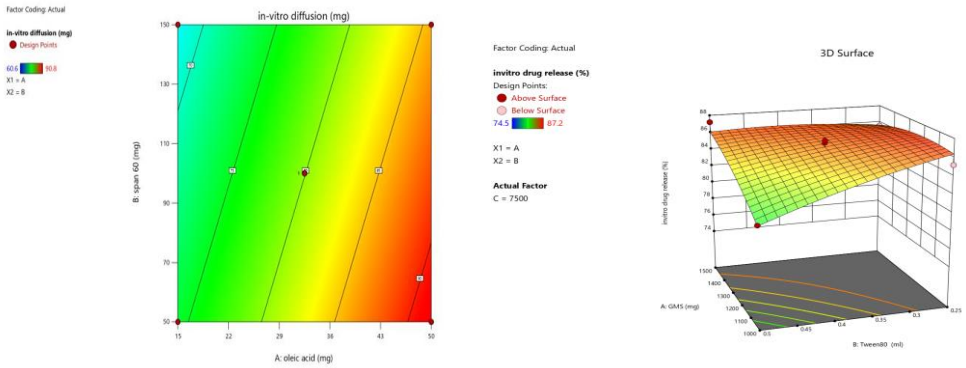


Figure 3: 3D contour diagrams illustrating relationship among the various factors on.

In-vitro diffusion

The contour diagram for *in vitro* drug diffusion displayed gradually curved and evenly distributed response lines, indicating a gradual and incremental change in permeation as Span 60 and Ethanol levels were varied as shown in Figure 3. The 3D response surface map indicated peak diffusion at moderate factor concentrations, with a progressive decline in diffusion at extreme values, attributable to heightened vesicular rigidity or structural destabilization. These findings confirmed the presence of optimal factor concentrations for maximizing drug permeation.

Selection of the optimal formulation was accomplished through desirability function analysis and overlay plot assessment. The optimized formulation (F14) exhibited a mean vesicle diameter of 138 nm and a zeta potential of 8.5 mV. Drug content and encapsulation efficiency of the optimized Curcumin loaded Ufasomes were measured to be 80.3% and 85.3% respectively.

The optimized ufasomal preparation (Table 3) was then incorporated into a Carbopol 934-based gel and comprehensively evaluated. The resulting gel exhibited a viscosity of 10500±500 cP, spreadability of 14.8±0.5 g.cm/sec, and a pH of 4.5±0.2, all confirming physicochemical suitability for topical use.

Table 3: Optimized Ufasomal gel formulation (F14).

SL.NO	INGREDIENTS	QUANTITY
1.	Curcumin	0.5 mg
2.	Ethanol	20ml
3.	Cholesterol	5mg
4.	Oleic acid	2ml
5.	Span 60	1ml
6.	Carbopol 934	3mg

In vitro diffusion evaluation of the optimized ufasomal gel (F14) was conducted using a Franz diffusion cell with phosphate buffer (pH 4.5) as the receptor fluid. The diffusion study revealed a sustained drug permeation profile, with cumulative drug release reaching 93.4±0.9% at the conclusion of the 8-hour experiment, as shown in Table 4.

Table 4: *In vitro* drug diffusion of optimized ufasomal gel.

Sl.no	Time	Optimized Formulation (F3)
1.	30	18.2±0.6
2.	60	29.5±0.8

3.	120	42.8±1.1
4.	180	55.6±1.3
5.	240	67.4±1.5
6.	300	76.8±1.4
7.	360	84.2±1.2
8.	420	89.1±1.0
9.	480	93.4±0.9

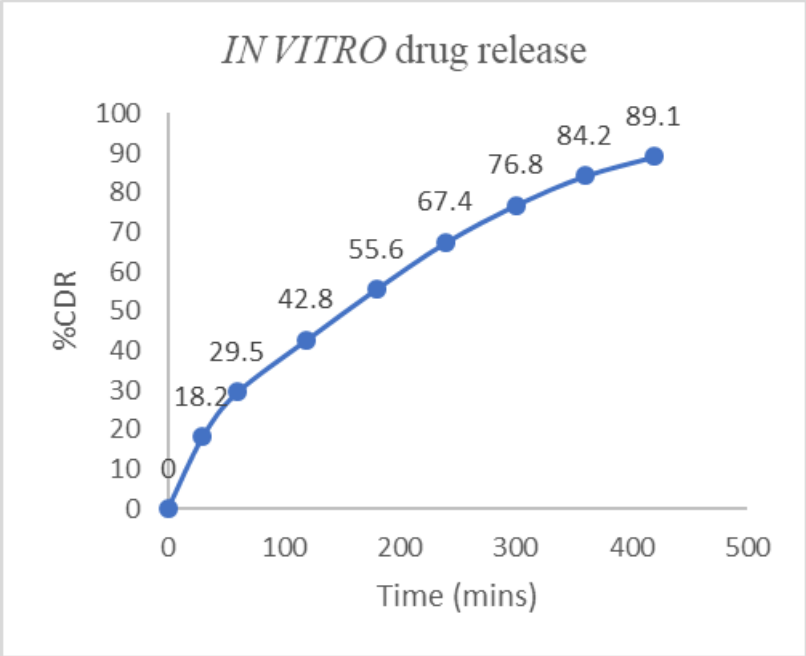


Figure 4: Invitro drug release of Curcumin ufasomes.

Table 5 shows Kinetic analysis of the optimized gel yielded a Korsmeyer–Peppas r² value of 0.9935 and an n value of 0.5916, confirming Non-Fickian (anomalous) drug release as the governing transport mechanism.

Table 5: Kinetic studies for optimized ufasomal gel formulation F3.

Kinetics		**r^2**
Zero order		0.9574
First order		0.5706
Higuchi		0.9939
Korsmeyer-Peppas	**r^2**	0.9935
	n	0.5916

SEM micrographs of Curcumin Loaded Ufasomes confirmed the development of discrete vesicular structures with smooth surface textures and spherical morphology, as illustrated in Figure 5.

Zeta Potential	
Mobility	0.84 μm s^{-1} V^{-1} cm
Zeta Potential	10.8 mV
Charge	0.033 fC
Polarity	Positive
Conductivity	9,188 μS/cm
Field Strength	1.0 kV/cm
Sample Information	
Fluid	
CURCUMIN UFASOMES	
Viscosity	0.834
Temperature	27.92 °C
Dielectric Constant	79
Dispersant	
pH	7
Concentration	
Concentration	

Figure 5: Scanning electron microscopy of optimised Curcumin Loaded Ufasomes.

Zeta potential measurement of the optimized ufasomal preparation yielded a value of 8.5 mV, indicating sufficient electrostatic repulsion between vesicles and satisfactory colloidal stability.

Particle size analysis of the optimized formulation identified a maximum vesicle diameter of 138 nm (Figures 6 and 7). The nanoscale dimensions of the vesicles confirmed uniform size distribution and their suitability for cutaneous drug delivery applications.

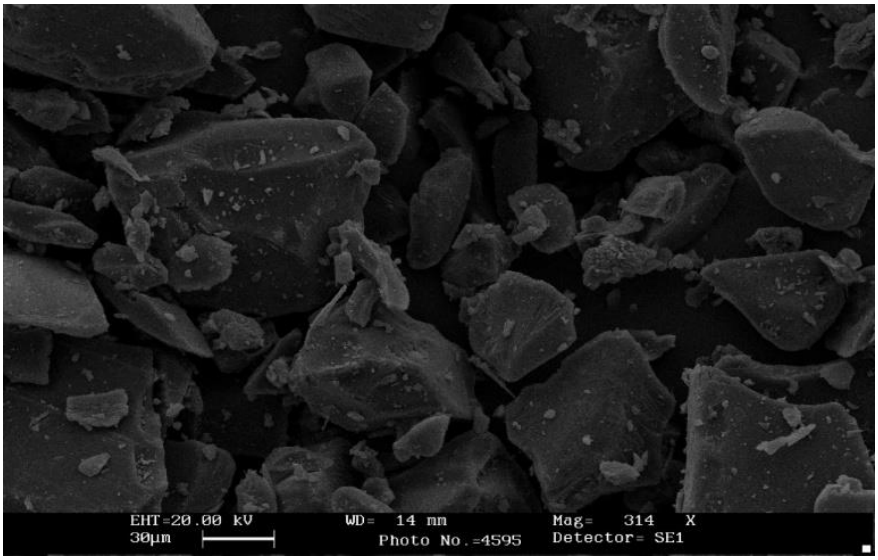


Figure 6: Zeta Potential of Curcumin ufasomes.

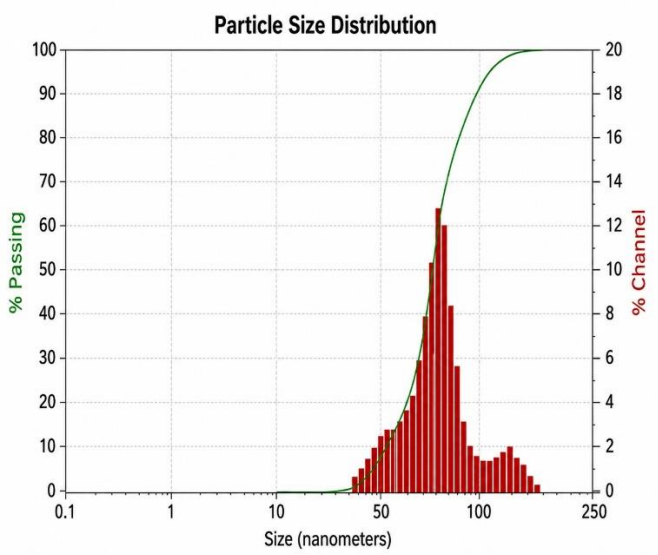


Figure 7: Particle size of Curcumin Ufasomes.

CONCLUSION

The present study successfully developed and optimized a Curcumin-loaded ufasomal vaginal gel for localized vaginal delivery using the ethanol injection method and Central Composite Design. Oleic acid, Span 60, and cholesterol significantly influenced entrapment efficiency and *in-vitro* drug release. The optimized ufasomal formulation exhibited an entrapment efficiency of 61.8 ± 0.012%, particle size of 138 nm, and zeta potential of 8.5 mV.

FTIR studies confirmed drug–excipient compatibility, while SEM revealed spherical vesicles with smooth surface morphology. The optimized formulation demonstrated controlled drug release of 78.2 ± 0.859% over 8 hours and showed non-Fickian diffusion behaviour, indicating a combined release mechanism involving diffusion and vesicular membrane relaxation.

The optimized ufasomes were successfully incorporated into a Carbopol 934 vaginal gel base. The gel was smooth and homogeneous and exhibited satisfactory pH, viscosity, and spreadability, indicating its suitability for vaginal application. Overall, the developed Curcumin loaded ufasomal vaginal gel represents a promising localized delivery system for vaginal cancer therapy, with potential to improve Curcumin retention, controlled release, therapeutic efficacy, and patient compliance.

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REFERENCE

1. Adams TS, Cuello MA. Cancer of the vagina. *Int J Gynaecol Obstet,* 2018; 143(Suppl 2): 14–21.
2. Ng QJ, Namuduri RP, Yam KL, Lim-Tan SK. Vaginal metastasis presenting as postmenopausal bleeding. *Case Rep Obstet Gynecol.,* 2015; 56(8): e134-6.
3. Adams TS, Cuello MA. Cancer of the vagina. *Int J Gynaecol Obstet.* 2018; 143(Suppl 2): 14-21.
4. Hewlings SJ, Kalman DS. Curcumin: a review of its effects on human health. *Foods,* 2017; 6(10): 9-22.
5. Vadukoot AK, Mottemmal S, Vekaria PH. Curcumin as a potential therapeutic agent in certain cancer types. *Cureus*, 2023; 15(1): e1-13.
6. Patel H. A vesicular drug delivery for futuristic drug delivery applications: ufasomes. Indian J Pharm Biol Res., 2022; 10(04): 1-3.
7. Navjot Singh, Gurjeet Singh, Lakhvir Kaur, R K Dhawan, Gurpreet Singh Sandhu, Manu Sharma, Manjeet Kaur. Ufasomes: An Emerging Vesicular System and A Comparative Study with Other Vesicular Carriers. Int J Pharm Sci Res., 2022; 74(2): 133-138.
8. Nayak AK, Hasnain MS, Aminabhavi TM, Torchilin VP. Nanovesicular systems in drug delivery. InSystems of Nanovesicular Drug Delivery, 2022: 1-15. Academic Press.
9. Lakshmi VS, Manohar RD, Mathan S, Dharan SS. Formulation and evaluation of ufasomal topical gel containing selected non- steroidal anti- inflammatory drug (NSAIDs). J. Pharm. Sci., 2021; 13(1): 38-48.
10. Shinde NG, Aloorkar NH, Kulkarni AS. Recent advances in vesicular drug delivery system. Res. J. Pharm. Dosage Forms Technol., 2014; 6(2): 110-20.
11. Attia MS, Abdel-Mottaleb MS, Mohamed EH. Smart nanovesicles for drug delivery. Syst Nanovesicular Drug Deliv., 2022; 2(1): 367-85.
12. Rajni S, Singh DJ, DN P, Shabnam H. Advancement in Novel Drug Delivery System: Niosomes. J. Drug Deliv. Ther., 2019; 9: 995
13. Nagasa GD, Belete A. Review on nanomaterials and nano-scaled systems for topical and systemic delivery of antifungal drugs. J. Multidiscip. Health c. 2022; 15: 1819-40.

14. Lakshmi VS, Manohar RD, Mathan S, Dharan SS. Ufasomes: A potential vesicular carrier system. J Pharm Sci Res., 2020; 12(10): 1332-5.
15. Luke PM, Joseph T. Ufasomes: Rising technology for delivery of drugs. Int. J. Med. Pharm. Sci., 2021; 11(11): 1-7.